EMS7/ECAM8 Abstracts,
Vol. 4, EMS2007-A-00110, 2007
7th EMS Annual Meeting / 8th ECAM

Variations of the northern Atlantic climate dynamic. Assessment at two time scales : a modern and a past one.

A.Pommier (1), D. Soto (1)

(1) Laboratoire Climatologie Risques Environnement, CRGA-UMR 5600. Université Lyon III, 18 rue Chevreul, Case 20, 69362 Lyon Cedex 07

The understanding of present and past climate dynamic is a major problem posed for scientists, notably in the context of a probable global warming. In this study, we try to bring some responses to this crucial issue by evaluating the evolution of Highs and Lows features at two time scales : a modern one (1950-2000) and a past one : the Weichselian Late Glacial (specially between 15 and 11,5 cal ky BP). We particularly focus on the Northern Atlantic region, which can be considered as a key place concerning the climate dynamic of the Northern Hemisphere.

To understand the modern climate dynamic, we use data extracted from NCEP-NCAR Reanalysis (http://cdc.noaa.gov/cgi-bin/njph-nc/Datasets). Computations were done using the free statistical package R, (http://cran.r-project.org). Working from NCEP/NCAR Sea Level Pressure daily records from 01/01/1950 to 12/31/2000, we have retraced, using a method developed by Favre and Gershunov (2003, 2006) the trajectories of the Highs. This method is divided into two successive automated stages:

- Recognition of the maxima of pressure on each map, concerning each day of the period,

- Connections between the different maxima during their movement, at all the measures of time (synoptic, seasonal, annual for the whole period) with some of their characteristics: latitude (genesis, lysis, mean), longitude (genesis, lysis, mean), pressure (max, min, mean), speed of displacement, distance, duration and surface. Working from a method developed in Pommier and Leroux (2004), we establish an index

for different time series which explains the Northern Atlantic climate dynamic.

We also analyse the link between the reduction of the intertropical aerological space and the dramatic decrease of rainfall in the Sahel region.

This work gives relevant results : in the Northern Atlantic region, two different periods have been highlighted : between 1950 and 1970, climate dynamic decreases whereas it becomes stronger and stronger between 1970 and 2000. We also shown that the Northern Atlantic Highs are able to go further southward for 1970 to 2000 in the intertropical region while the South Atlantic ones are able to go further northward.

So the “space” between those two elements get thinner and that can be an explanation why the amount of rain decreases strongly in the Sahel region during the same period.

Reconstructing climatic patterns at a palaeoclimatic scale is a complex exercise because raw data are not available so they must be interpreted from proxies. Concerning the Weichselian Late Glacial, it is well known that it is characterized by a succession of abrupt and widespread climatic changes, like the Younger Dryas, which is one of the best studied event.

To better understand these climatic variations, a multi-proxy dataset has been created from specialized publications and from electronic datasets (World Data Center A for Palaeoclimatology, NAPD, EPD, Oxford or MPDB ones). Currently, our database numbers more than 600 sites mainly spread in the Northern Atlantic region. This multi-proxy approach focuses on two means to reconstruct abrupt climatic changes:

the first one consists in compiling several indicators to estimate qualitative parameters (warmth, cold, rainfall characteristics, direction and intensity of the wind) ; the second one is to quantify, at a large scale, climatic values, such as temperature and precipitation.

Both means are integrated in a Geographical Information System. The purpose of this GIS is to provide an useful tool, which requires few computation and geostatistical knowledge. Currently, it is possible, thanks to this powerful tool, to produce a relatively sharp estimation of the spatial repartition of temperature and precipitation with a high temporal resolution. By focusing on these climatic interpolations, we experiment a new model, which gives good results concerning the understanding of past climate changes (Leroux, 1993, Soto, 2004). Without neglecting the certain retroactive role of oceanic, volcanic and even solar factors, it is thought that the main reason triggering abrupt climate changes is an acceleration or a slow-down of the aerological dynamic driven by Highs coming from polar latitudes. During the Late Glacial period, they are mainly influenced by the various and complex geometry of the huge laurentide and fenno-scandian ice domes.

So, we can conclude that the Northern Atlantic climate is triggered by the evolution of Highs and Lows and by the dynamic of theirs trajectories, particularly at a palaeoclimatic scale. This result is significant and highlights the crucial role played by the dynamic of Highs in the past and present atmospheric circulation.

References :

Favre A., Gershunov A., 2006 : Extra-tropical cyclonic/anticyclonic activity in North-Eastern Pacific and air temperature extremes in Western North America, *Climate Dynamics.*

Leroux M., 1993 : The Mobile Polar High : a new concept explaining present mechanisms of meridional airmass and energy exchanges and global propagation of palaeoclimatic changes. *Global and Planetary Change*, **7**, 69-93.

Pommier A., Leroux M., 2004 : Poster named : "Relationships between the Features Variations of Highs and Lows in the North Atlantic Region and North Atlantic Oscillation from 1950 to 2000", *1st International CLIVAR Science Conference*, Baltimore, USA.

Pommier A., 2006 : Analyses of Highs and Lows tracks in South and North Atlantic from 1950-2000, 6th *EMS*, Ljubljana, Slovenia, 4-8 September 2006.

Soto D., 2004 : Réinterprétation conceptuelle d'épisodes climatiques tardiglaciaires dans l'espace Atlantique Nord. *Environnements Périglaciaires*, 11, p.83-92.

Soto D., 2006 : Poster named : « Analyse des moteurs des variations climatiques de courte durée au Tardiglaciaire ». *Q5 : Le Quaternaire : Limites et Spécificités*, Paris, 1-3 February 2006.